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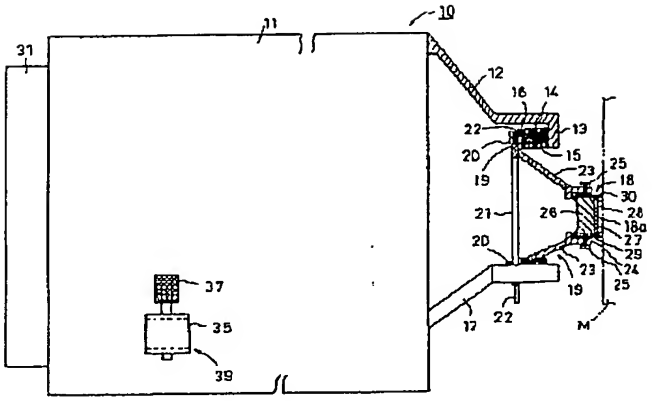
TITLE : DETECTING DEVICE FOR MATERIAL DETERIORATION BY POSITRON ANNIHILATION METHOD



ABSTRACT : PURPOSE: To obtain a material deterioration detector by means of a positron annihilation method capable of detecting a material deterioration easily and at a high precision, directly transporting it to a job site and safely detecting the material deterioration.

CONSTITUTION: A γ-ray detector 31 is provided through a distance adjustment mechanism 39 composed of a rack 38 and a pinion 36 on a support cylinder 11 and ahead thereof a positron source installment 18 integrating a positron source 18a through an aluminum-made packing material 26 is detachably mounted through a positron source holder 19. Thereby preparations for detection can be made only by bringing the positron source 18a including a γ-ray detector 31 into contact with a specimen to be measured M in parallel for the purpose of detection of a material deterioration. In addition, the γ-ray detector 31 is detached from the support cylinder 11 including a positron source holder 19, housed in a lead-made pot and the like, and transport and the like can be performed safely. Furthermore, the position of the γ-ray detector 31 is adjusted in accordance with intensity of positrons from the positron source 18a so that highly precise detection may be performed in a uniform condition.

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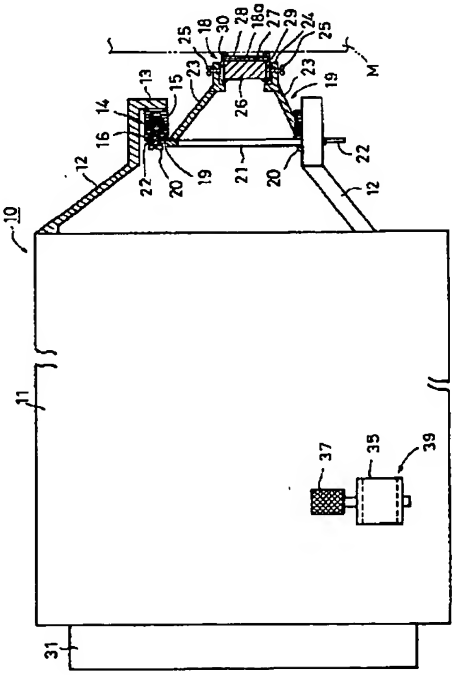
(54)【発明の名称】　陽電子消滅法による材料劣化検出装置

(57)【要約】

【目的】　簡単かつ高精度に材料の劣化が検出でき、直接現場に運んで安全に検出できる陽電子消滅法による材料劣化検出装置を提供することにある。

【構成】　サポートシリンダ１１にラック３８とピニオン３６による距離調整機構３９を介してγ線検出器３１を設け、この前方にアルミニウムのパッキン材２６を介して陽電子源１８ａを一体化した陽電子源装着体１８を陽電子源ホルダ１９を介して着脱自在に取付ける。これにより、陽電子源１８ａをγ線検出器３１ごと被測定試料Ｍに平行に押し当てるだけで検出準備ができ、材料Ｍの劣化を検出できる。また、陽電子源ホルダ１９ごとサポートシリンダ１１から取外し、鉛のポット等に収納し、運搬等を安全に行うことができる。さらに、距離調整機構３９による距離の調整で、陽電子源１８ａからの陽電子の強さによってγ線検出器３１の位置を調整して均一な条件で高精度の検出を行う。



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【特許請求の範囲】

【請求項1】　陽電子源と、この陽電子源で発生する陽電子を被測定試料に照射し、電子との対消滅によって生じるγ線のエネルギ分布を測定するγ線検出器とを備えた陽電子消滅法による材料劣化検出装置において、前記γ線検出器の前方にパッキング材を介して前記陽電子源を一体に取付けたことを特徴とする陽電子消滅法による材料劣化検出装置。

【請求項2】　前記γ線検出器の前方に被測定試料表面と平行に密着可能に可撓性支持機構を介して前記陽電子源を着脱可能に支持したことを特徴とする請求項1記載の陽電子消滅法による材料劣化検出装置。

【請求項3】　前記γ線検出器の前方に陽電子源での発生陽電子に応じて前記陽電子源と前記γ線検出器との距離を調整する距離調整機構を設けたことを特徴とする請求項1または2記載の陽電子消滅法による材料劣化検出装置。

【請求項4】　前記陽電子源の被測定試料への密着側をポリマフィルムで覆って密封線源としたことを特徴とする請求項1ないし3のいずれかに記載の陽電子消滅法による材料劣化検出装置。

【請求項5】　前記陽電子源の側方に鉛を備えた遮蔽筒を設けるとともに、この遮蔽筒の前方に前記陽電子源の前面を覆う鉛を備えたキャップを着脱可能に設けたことを特徴とする請求項1ないし4のいずれかに記載の陽電子消滅法による材料劣化検出装置。

【発明の詳細な説明】

【0001】

【産業上の利用分野】この発明は、陽電子消滅によるγ線を検出して材料の表面近傍の状態を非破壊で詳しく調べることができる材料劣化検出装置に関し、簡単かつ高精度に検出できるとともに、安全に取扱うことができるようにしたものである。

【0002】

【従来の技術】陽電子は電子の反粒子であり、電子と同じ質量とスピンを持つが、電子と逆の正の電荷を持っており、電子と対消滅してγ線を発生する。このγ線のエネルギ分布は物質中の電子の運動エネルギによって左右される。物質中に原子空孔など微細な欠陥が存在すると、陽電子はこれに捕獲され、最外郭電子との消滅の割合が多くなり、γ線エネルギ分布のナロウィングがおこる。

【0003】この陽電子消滅現象を利用し、材料に陽電子を照射し、その対消滅によって発生するγ線のエネルギ分布を計測すること等は、材料表面の材料の格子欠陥分布や多層膜構造、界面の電子構造などについて重要な情報を得ることができ、高感度で行える材料の劣化検出法として注目されつつある。

【0004】この陽電子消滅法を利用して材料の劣化を検出するためには、被測定試料に陽電子を照射するとともに、対消滅によって生じる材料からのγ線を検出する必要がある。

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【0005】そこで、これまで行われている陽電子消滅法による材料の劣化の検出では、実際の機械等から切り取って測定すべき試料を用意し、周囲の種々の物質（空気）での対消滅を無くし、試料からのγ線のみを検出できるようにするため、図9に示すように、陽電子源1としてのラジオアイソトープを2つの試料2，3の間に挟むようにする。こののち、陽電子源1と一定距離のところに発生するγ線を検出するγ線検出器4を置いて検出するようにしている。

【0006】

【発明が解決しようとする課題】このような陽電子源1と、これを測定するγ線検出器4とを用いて材料2（または材料3）の劣化を検出する場合には、1つの被測定試料を半分に切り、研磨して2つの試料としたのち、これら測定試料2，3の間に陽電子源1を挟んで被測定試料としなければならず、被測定試料の準備が大変であるとともに、実際に使用されている機器の材料の劣化を知る必要がある場合には、少なくとも一部分を破壊して試料を得なければならないという問題がある。

【0007】また、測定の際、陽電子源1とγ線検出器4との距離が変わると測定精度が変化するという問題がある。

【0008】さらに、陽電子源1として用いるラジオアイソトープは放射性物質であり、その取扱などに注意が必要で、法上の規制もあり、実際に使用されている機器の構成材料などの劣化を測定対象とする場合に周囲環境への放射線の影響のための制約がある。

【0009】また、陽電子源1からの陽電子が周囲の金属などに照射されることを極力防止するように、陽電子源1を2つの試料2，3の間に挟むようにしているものの、陽電子が空気中もしくは消滅γ線エネルギ分布が未知の物質などに照射されると、この部分においても陽電子消滅が生じてγ線が発生するため、これがノイズとなって測定精度が低下するという問題もある。

【0010】この発明は、かかる従来技術の問題点に鑑みてなされたもので、被測定試料を破壊して得る必要がなく、簡単かつ高精度に測定できるとともに、測定現場に運んで安全に測定することができる陽電子消滅法による材料劣化検出装置を提供しようとするものである。

【0011】

【課題を解決するための手段】上記従来技術が有する課題を解決するため、この発明の陽電子消滅法による材料劣化検出装置は、陽電子源と、この陽電子源で発生する陽電子を被測定試料に照射し、電子との対消滅によって生じるγ線のエネルギ分布を測定するγ線検出器とを備えた陽電子消滅法による材料劣化検出装置において、前記γ線検出器の前方にパッキング材を介して前記陽電子源を一体に取付けたことを特徴とするものである。

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【0012】また、この発明の陽電子消滅法による材料劣化検出装置は、第1の発明の前記γ線検出器の前方に被測定試料表面と平行に密着可能に可撓性支持機構を介して前記陽電子源を着脱可能に支持したことを特徴とするするものである。

【0013】さらに、この発明の陽電子消滅法による材料劣化検出装置は、第1および第2の発明の前記γ線検出器の前方に陽電子源での発生陽電子に応じて前記陽電子源と前記γ線検出器との距離を調整する距離調整機構を設けたことを特徴とするものである。

【0014】また、この発明の陽電子消滅法による材料劣化検出装置は、第1ないし第3の発明の前記陽電子源の被測定試料への密着側をポリマフィルムで覆って密封線源としたことを特徴とするものである。

【0015】さらに、この発明の陽電子消滅法による材料劣化検出装置は、第1ないし第4の発明の前記陽電子源の側方に鉛を備えた遮蔽筒を設けるとともに、この遮蔽筒の前方に前記陽電子源の前面を覆う鉛を備えたキャップを着脱可能に設けたことを特徴とするものである。

【0016】

【作用】この陽電子消滅法による材料劣化検出装置によれば、γ線検出器の前方にアルミニウム等のパッキン材を介して陽電子源を一体に取付けるようにしており、この陽電子源をγ線検出器ごと被測定試料に平行に押し当てるだけで検出準備ができ、材料の劣化を検出することができるようにしている。

【0017】また、この陽電子消滅法による材料劣化検出装置によれば、γ線検出器の前方に設ける陽電子源をバネなどによる可撓性支持機構を介してネジ等で着脱自在に取付けるようにしており、γ線検出器の押付方向のずれをバネなどの可撓性支持機構で吸収して被測定試料表面に平行に密着できるようにするとともに、この陽電子源だけを可撓性支持機構部分から取外し、鉛のポット等に収納できるようにし、運搬等を安全に行うことができるようにしている。

【0018】さらに、この陽電子消滅法による材料劣化検出装置によれば、γ線検出器の前方に設ける陽電子源との間に距離調整機構を設けて距離を調整できるようにしており、陽電子源の崩壊数または強度によってγ線検出器の位置を調整して測定条件を同一にできるようにし、時間の経過とともに強度が低下する陽電子源によっても高精度の検出ができるようにしている。

【0019】また、この陽電子消滅法による材料劣化検出装置によれば、γ線検出器の前方の陽電子源のアルミニウム等のパッキン材と反対側の被測定試料への密着側をポリマフィルムで覆うようにしており、この陽電子源をパッキン材とポリマフィルムで覆うことで密封線源として運搬や測定場所の制約を減少し、取扱を容易とするとともに、安全性を向上している。

【0020】さらに、この陽電子消滅法による材料劣化

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検出装置によれば、陽電子源の側方に鉛のライニングを備えた遮蔽筒を設けるとともに、前方にも鉛のライニングを備えたキャップを着脱できるように設けており、測定現場などに運搬する場合の安全性を一層向上でき、測定の際に、キャップだけを外すことで側方からの外部ノイズの影響を防止できるようにしている。

【0021】

【実施例】以下、この発明の実施例を図面に基づき詳細に説明する。図1～図6はこの発明の陽電子消滅法による材料劣化検出装置の一実施例にかかり、図1は先端部分のみを縦断面にして示す断面図、図2は可撓性支持機構など先端部分の拡大断面図、図3は図2中のA－A矢視図、図4は着脱機構など先端部分の概略斜視図、図5は位置調整機構の縦断面図、図6は位置調整機構の横断面図である。

【0022】この陽電子消滅法による材料劣化検出装置10は、円筒状のサポートシリンダ11を供えており、その先端部に、図4に示すように、円周方向3箇所から突き出してメインアーム12が一体に取付けられ、3本のメインアーム12は円すい面に沿って窄まって先端部がサポートシリンダ11の中心軸と平行な水平とされたのち中心に向かってL字状に曲げられ、固定部13が形成されている。このメインアーム12の先端の固定部13には、可撓性支持機構14を構成するバネ15の先端が一体に取付けられ、このバネ15の後端に雌ネジ16が形成された固定板17が一体に取付けてある。

【0023】これら半径方向3箇所に設けられた固定板17には、陽電子源18aが一体化された陽電子装着体18を支持する陽電子源ホルダ19がボルト20で着脱自在に取付けられる。

【0024】この陽電子源ホルダ19は、図1～図4に示すように、リング状の取付板21を備え、その円周方向3箇所に外側に突き出してメインアーム12の固定部13と対向させることができる取付部22が形成され、ボルト20を挿入して固定部13の雌ネジ16に締付けて固定したり、ボルト20をゆるめて取外すことができ、メインアーム12の固定部13に対して陽電子源ホルダ19の取付部22をサポートシリンダ11の中心軸回りに回動して対向位置からずらすようにすることで、メインアーム12の前方に陽電子源ホルダ19を取出すことができる。

【0025】この陽電子源ホルダ19では、リング上の取付板21の前方に円すい面に沿って3本の支持アーム23が円周方向等間隔に配置されて一体に取付けてあり、これら支持アーム23の先端に円筒状の陽電子源固定筒24が取付けてある。

【0026】この陽電子源固定筒24の対角位置に2本の止めネジ25がねじ込まれ、陽電子源18aが一体化された陽電子装着体18を挟んで固定できるようになっている。

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【００２７】この陽電子源固定筒２４に止めネジ２５で挟んで取付けられる陽電子源１８ａが一体化された陽電子装着体１８は、たとえば図２に示すように、直径が５mm程度で厚さが３mm程度のアルミニウム製の円板状のバッキング材２６の前方に厚さが０．０５mm程度のニッケルフォイル２７が配置され、これらの中心に直径が１mm程度のラジオアイソトープであるゲルマニウム６８が陽電子源１８ａとして配置され、さらにその外側に０．１mm程度の厚さのポリマフィルム２８が積層され、これらの周囲にアルミニウム板２９が巻かれ、両端の折曲部３０で押えて積層状態を保持するように構成されている。

【００２８】次に、サポートシリンダ１１へのγ線検出器３１の取付構造について、図５および図６により説明する。

【００２９】円筒状のサポートシリンダ１１の内周の円周方向に３等分した位置に２本のスライドレール３２が軸方向と平行に取付けられており、２本のスライドレール３２と嵌合してスライドするあり溝が形成されたスライダ３３が軸方向３箇所に配置されたリング状の検出器取付筒３４の外側に取付けられてサポートシリンダ１１に対して軸方向にスライドできるようになっている。また、サポートシリンダ１１の円周方向に３等分した残りの一箇所には、外側に突き出してピオニオン取付部３５が形成されてピニオン３６が設けられ、ピニオン３６のピニオン取付部３５の外側の回転軸につまみ３７が設けられ、手で回転駆動できるようになっている。そして、このピニオン３６と噛み合うラック３８が検出器取付筒３４の外側に固定してあり、つまみ３７でピニオン３６を回転することで、検出器取付筒３４をサポートシリンダ１１に対して軸方向に移動することができる距離調整機構３９が構成されている。

【００３０】このような距離調整機構３９の検出器取付筒３４の内部には、γ線検出器３１が取付けられ、センサ部分が陽電子源１８ａ側となるようにしてある。

【００３１】なお、この距離調整機構３９には、図示省略したが、陽電子源１８ａに対して所定距離にγ線検出器３１を調整した後固定できるように、ネジ等による固定機構が設けてある。

【００３２】このように構成した陽電子消滅法による材料劣化検出装置１０では、次のようにして材料Mの劣化の検出が行われる。

【００３３】まず、準備として、陽電子源ホルダ１９の先端の陽電子源固定筒２４にアルミニウム板２９の折曲部３０で積層状態が保持された陽電子源１８ａが一体化された陽電子装着体１８を２本の止めネジ２５で固定しておき、陽電子源ホルダ１９ごと鉛製ポット等に収納して保管しておく。

【００３４】一方、サポートシリンダ１１の内側の検出器取付筒３４には、γ線検出器３１を取付けておく。

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【００３５】こうして準備が完了した後、被測定試料Mがある現場にサポートシリンダ１１部分と鉛製ポットに入れた陽電子源ホルダ１９を運び、サポートシリンダ１１の先端部のメインアーム１２の先端の３箇所の固定部１３とぶつからないように陽電子源ホルダ１９の基端部の３箇所の取付部２２をメインアーム１２の内側に入れた後、サポートシリンダ１１の中心軸回りに回動して固定板１７と取付部２２を対向させ、ボルト２０で固定する。

【００３６】これにより、陽電子源１８ａが一体化された陽電子装着体１８が取付けられた陽電子源ホルダ１９はバネ１５を介してサポートシリンダ１１のメインアーム１２の先端に取付けられ、陽電子源１８ａが一体化された陽電子装着体１８がサポートシリンダ１１に対して中心軸に対して傾いたり、前後方向に動くことができる。

【００３７】こののち、距離調整機構３９のつまみ３７を回転して陽電子源１８ａに対してγ線検出器３１の距離を調整し、図示しない固定機構で固定する。

【００３８】この距離調整機構３９によって陽電子源１８ａからの発生陽電子の強度が変化してもこれによってγ線検出器３１の位置を変えることができ、特に、時間の経過などによって発生陽電子の強度が低下してもさらに使用することができる。

【００３９】こうして全ての検出準備が完了した後、図１および図２に示すように、サポートシリンダ１１ごと被測定試料Mの測定部分に陽電子源ホルダ１９先端の陽電子源１８ａが一体化された陽電子装着体１８を押し当てる。

【００４０】このとき、被測定試料Mの測定部分が傾斜面などであっても、陽電子源１８ａが一体化された陽電子装着体１８が陽電子源ホルダ１９を介してサポートシリンダ１１にバネ１５を介して支持されているので、サポートシリンダ１１の位置が多少ずれても被測定面に平行に陽電子源１８ａが一体化された陽電子装着体１８を密着させることができる。

【００４１】この状態で、被測定試料Mの測定部分からのγ線のエネルギ分布をγ線検出器３１で測定することで材料Mの劣化を検出することができる。

【００４２】この被測定部分からのγ線をγ線検出器３１で測定する場合、陽電子が被測定面だけでなく、他の方向にも照射されノイズとなることがあるが、陽電子源１８ａの背面にアムミニウムのバッキング材２６が配置して陽電子装着体１８が構成してあるので、この部分からのみの影響を考慮すれば良く、アルミニウムからは一定のエネルギのγ線が発生することから常に安定した状態で材料Mからのγ線を測定することができる。

【００４３】また、この装置では、陽電子源１８ａをバッキング材２６およびニッケルフォイル２７上に配置してポリマフィルム２８で覆い、周囲をアルミニウム板２

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9で囲むようにして陽電子装着体１８を構成しており、密封線源となり、法律上の規制も少なく、その取扱が容易であり、測定場所の制約も少なく、現場での測定が簡単にできる。

【００４４】次に、この発明の他の一実施例について図７および図８により説明するが、既に説明した実施例と同一部分については同一記号を記し、説明は省略する。

【００４５】この陽電子消滅法による材料劣化検出装置４０では、測定現場などへの運搬の安全性の向上と外部ノイズによる測定精度低下を極力抑えるようにしており、サポートシリンダ１１の先端部のメインアーム１２や陽電子源装着体１８等の側方を覆うように遮蔽筒４１が取付けてある。この遮蔽筒４１の内側には、陽電子やγ線を遮蔽する鉛のライニング４２が取付けてある。そして、この遮蔽筒４１の先端部には、着脱できるキャップ４３が取付けられ、測定の際には、取外し、運搬などの際には、取付けたままにできるようになっている。このキャップ４３の内側にも鉛のライニング４４が取付けてある。なお、他の構成は既に説明した実施例と同一である。

【００４６】このような遮蔽筒４１およびキャップ４３を設けることにより、測定の際には、キャップ４３のみを取外して使用するが、陽電子源装着体１８の側方が鉛のライニング４２を備えた遮蔽筒４１で覆われているので、陽電子源１８ａから被測定部以外に照射されて発生するγ線による外部ノイズとなることを防止することができる。

【００４７】また、運搬などの際には、キャップ４３を取付けておくことで、陽電子源１８ａからの陽電子を完全に遮蔽することができ、人体などのへの影響を与えず一層安全に取扱うことができる。

【００４８】さらに、既に説明した上記実施例と同様の効果も奏する。

【００４９】なお、上記実施例では、陽電子源としてゲルマニウム６８を用いるようにしたがこれに限らず、他の陽電子源を用いるようにしても良い。

【００５０】また、可撓性支持機構としてバネを介して支持するようにしたが、これに限らず、ゴムなどの可撓性材を介して支持するようにするなどしても良い。

【００５１】さらに、距離調整機構もラック・ピニオンによるものに限らず、他の構成としても良い。

【００５２】また、この発明は上記各実施例に限らず、この発明の要旨を逸脱しない範囲で各構成要素に変更を加えても良いことは言うまでもない。

【００５３】

【発明の効果】以上、一実施例とともに具体的に説明したようにこの発明の陽電子消滅法による材料劣化検出装置によれば、γ線検出器の前方にバッキン材を介して陽電子源を一体に取付けるようにしたので、この陽電子源をγ線検出器ごと被測定試料に平行に押し当てるだけで

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検出準備ができ、材料の劣化を簡単に検出することができるとともに、被測定試料以外からのγ線のノイズを一定に保ち検出精度を保つことができる。

【００５４】また、この陽電子消滅法による材料劣化検出装置によれば、γ線検出器の前方に設ける陽電子源を可撓性支持機構を介して着脱自在に取付けるようにしたので、γ線検出器の押付方向のずれを可撓性支持機構で吸収して被測定試料表面に平行に密着することができるとともに、この陽電子源だけを可撓性支持機構部分から取外して鉛のポット等に収納でき、運搬等を安全に行うことができる。

【００５５】さらに、この陽電子消滅法による材料劣化検出装置によれば、γ線検出器の前方に設ける陽電子源との間に距離調整機構を設けて距離を調整できるようにしたので、陽電子源の崩壊数または強度によってγ線検出器の位置を調整して測定条件をほぼ同一にでき、時間の経過等にともなって陽電子の強度が低下しても高精度の検出ができる。

【００５６】また、この陽電子消滅法による材料劣化検出装置によれば、γ線検出器の前方の陽電子源のバッキン材と反対側の被測定試料への密着側をポリマフィルムで覆うようにしたので、この陽電子源をバッキン材とポリマフィルムで覆うことで密封線源として運搬や測定場所の制約を減少し、取扱を容易とするとともに、安全性を向上することができる。

【００５７】さらに、この陽電子消滅法による材料劣化検出装置によれば、陽電子源の側方に鉛のライニングを備えた遮蔽筒を設けるとともに、前方にも鉛のライニングを備えたキャップを着脱できるように設けたので、測定現場などに運搬する場合の安全性を一層向上でき、測定の際に、キャップだけを外すことで側方からの外部ノイズの影響を鉛で防止することができ、測定精度を向上することができる。

【図面の簡単な説明】

【図１】この発明の陽電子消滅法による材料劣化検出装置の一実施例にかかる先端部分のみを縦断面にして示す断面図である。

【図２】この発明の陽電子消滅法による材料劣化検出装置の一実施例にかかる可撓性支持機構など先端部分の拡大断面図である。

【図３】この発明の陽電子消滅法による材料劣化検出装置の一実施例にかかる図２中のＡ－Ａ矢視図である。

【図４】この発明の陽電子消滅法による材料劣化検出装置の一実施例にかかる着脱機構など先端部分の概略斜視図である。

【図５】この発明の陽電子消滅法による材料劣化検出装置の一実施例にかかる位置調整機構の縦断面図である。

【図６】この発明の陽電子消滅法による材料劣化検出装置の一実施例にかかる位置調整機構の横断面図である。

【図７】この発明の陽電子消滅法による材料劣化検出装

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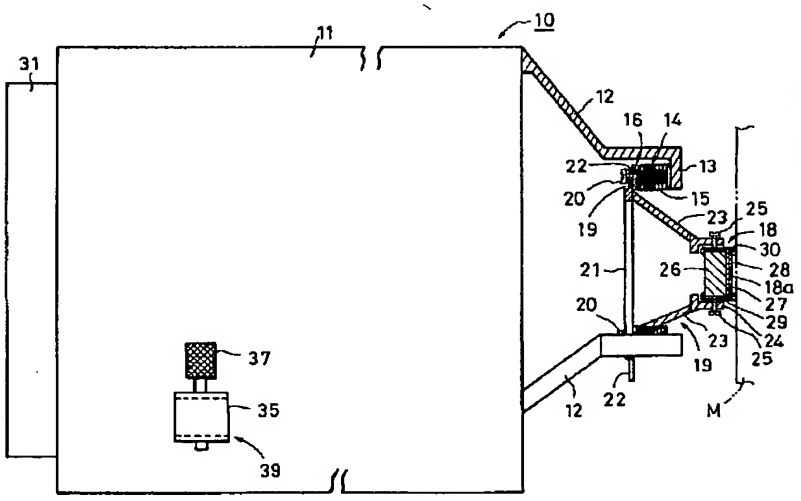
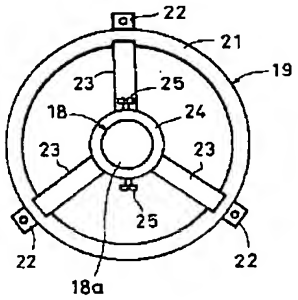
置の他の一実施例にかかる概略縦断面図である。
【図8】この発明の陽電子消滅法による材料劣化検出装置の他の一実施例にかかる側面図である。
【図9】従来の陽電子消滅法による材料劣化検出の概略説明図である。
【符号の説明】
10　陽電子消滅法による材料劣化検出装置
11　サポートシリンダ
12　メインアーム
13　固定部
14　可撓性支持機構
15　バネ
16　雌ネジ
17　固定板
18　陽電子源装着体
18a　陽電子源
19　陽電子源ホルダ
20　ボルト
21　取付板
22　取付部
23　支持アーム
24　陽電子源固定筒
25　止めネジ
26　パッキング材
27　ニッケルフォイル
28　ポリマフィルム
29　アルミニウム板
30　折曲部
31　γ線検出器
32　スライドレール
33　スライダ
34　検出器取付筒
35　ピニオン取付部
36　ピニオン
37　つまみ
38　ラック
39　距離調整機構
40　陽電子消滅法による材料劣化検出装置
41　遮蔽筒
42　鉛のライニング
43　キャップ
44　鉛のライニング
M　被測定試料（材料）

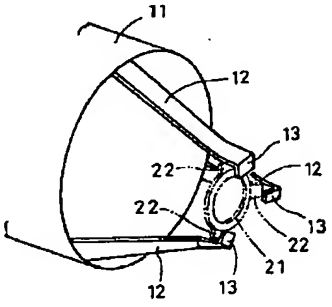
【図1】



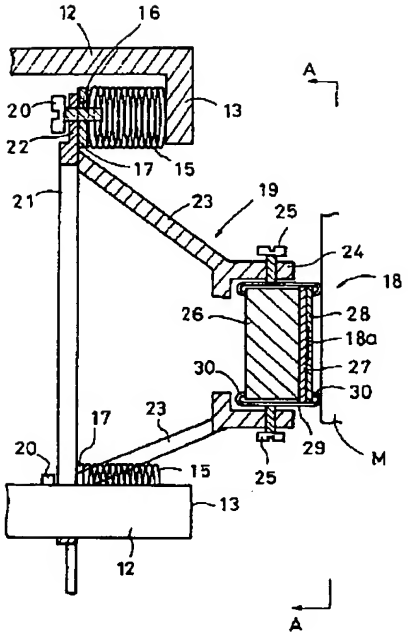
【図3】



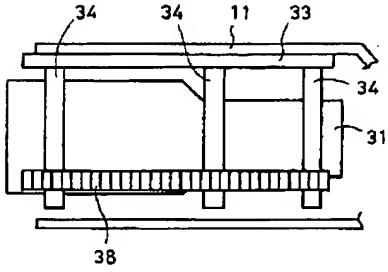
【図4】



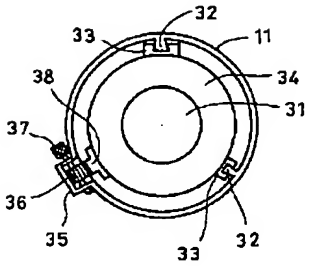
【図2】



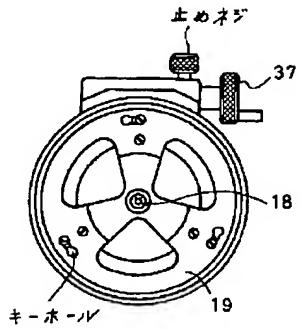
【図5】



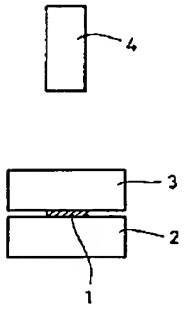
【図6】



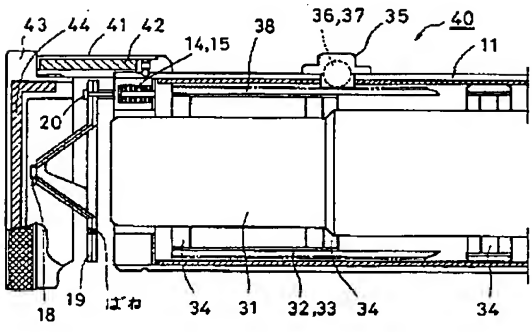
【図8】



【図9】



【図7】



JAPANESE [JP,05-288694,A]

CLAIMS DETAILED DESCRIPTION TECHNICAL FIELD PRIOR ART EFFECT OF THE INVENTION TECHNICAL PROBLEM MEANS OPERATION EXAMPLE DESCRIPTION OF DRAWINGS DRAWINGS

[Translation done.]

* NOTICES *

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CLAIMS

[Claim(s)]
[Claim 1] Ingredient degradation detection equipment by the positron-annihilation method characterized by to attach said source of positive electron in one through backing material ahead of said gamma ray detector in the ingredient degradation detection equipment by the positron annihilation method equipped with the gamma ray detector which measures the energy distribution of the gamma ray which irradiates the positive electron generated in the source of positive electron, and this source of positive electron at a device under test, and is produced by pair annihilation with an electron.
[Claim 2] Ingredient degradation detection equipment by the positron annihilation method according to claim 1 characterized by supporting said source of positive electron removable through a flexible support device possible [adhesion to a device-under-test front face and parallel] ahead of said gamma ray detector.
[Claim 3] Ingredient degradation detection equipment by the positron annihilation method according to claim 1 or 2 characterized by establishing the range adjustment device in which the distance of said source of positive electron and said gamma ray detector is adjusted according to the generating positive electron in the source of positive electron ahead of said gamma ray detector.
[Claim 4] Ingredient degradation detection equipment by the positron annihilation method according to claim 1 to 3 characterized by having covered the adhesion side to the device under test of said source of positive electron with the polymer film, and considering as a sealed source.
[Claim 5] Ingredient degradation detection equipment by the positron annihilation method according to claim 1 to 4 characterized by preparing the cap equipped with wrap lead for the front face of said source of positive electron ahead of this electric shielding cylinder removable while preparing the electric shielding cylinder equipped with lead in the side of said source of positive electron.

[Translation done.]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] While this invention is detectable simply and with high precision about the ingredient degradation detection equipment which can detect the gamma ray by positron annihilation and can investigate the condition near the front face of an ingredient in detail by un-destroying, it enables it to deal with it safely.
[0002]
[Description of the Prior Art] Although it is an electronic antiparticle and has the same mass and the same spin as an electron, positive electron has positive charge contrary to an electron, annihilates with an electron and generates a gamma ray. The energy distribution of this gamma ray is influenced by the kinetic energy of the electron in the matter. If detailed defects, such as an atomic hole, exist in the matter, positive electron will be captured by this, its rate [electron / maximum outline] of disappearance will increase, and NAROWINGU of gamma ray energy distribution will start it.
[0003] Measuring the energy distribution of the gamma ray which uses this positron annihilation phenomenon, irradiates positive electron at an ingredient, and is generated by that pair annihilation etc. can acquire information important about lattice defect distribution of the ingredient on the front face of an ingredient, multilayers structure, the electronic structure of an interface, etc., and it is attracting attention as a degradation detecting method of the ingredient which can be performed by high sensitivity.
[0004] In order to detect degradation of an ingredient using this positron annihilation method, while irradiating positive electron at a device under test, it is necessary to detect the gamma ray from the ingredient produced by pair annihilation.
[0005] So, in detection of degradation of the ingredient by the positron annihilation method performed until now, in order to prepare the sample which should cut out from an actual machine etc. and should be measured, to abolish pair annihilation with surrounding various matter (air) and to enable it to detect only the gamma ray from a sample, as shown in drawing 9 , the radioisotope as a source 1 of positive electron is inserted between two samples 2 and 3. He places the gamma ray detector 4 which detects the gamma ray generated at the place of the source 1 of positive electron, and fixed distance, and is trying to detect after this.
[0006]
[Problem(s) to be Solved by the Invention] In detecting degradation of an ingredient 2 (or ingredient 3) using such a source 1 of positive electron, and the gamma ray detector 4 which measures this After cutting and grinding one device under test in one half and considering as two samples, while having to consider as a device under test across the source 1 of positive electron among these test portions 2 and 3 and preparation of a device under test being serious When degradation of the ingredient of the device actually used needs to be got to know, there is a problem that at least a part must be destroyed and a sample must be obtained.
[0007] Moreover, in the case of measurement, when the distance of the source 1 of positive electron and a gamma ray detector 4 changes, there is a problem that the accuracy of measurement changes.
[0008] furthermore, the radioisotope used as a source 1 of positive electron -- the radioactive substance -- it is -- the handling etc. -- cautions -- required -- law -- there is also the upper regulation, and when making into the measuring object degradation of the component of the device actually used etc., there is constraint for the effect of the radiation to a perimeter environment.
[0009] Moreover, that the positive electron from the source 1 of positive electron is irradiated by the surrounding metal etc. so that it may prevent as much as possible Since positron annihilation will arise also in this part and a gamma ray will

occur, if positive electron is irradiated by the inside of air, or the matter with strange disappearance gamma ray energy distribution although he is trying to face across the source 1 of positive electron between two samples 2 and 3, The problem that become a noise and the accuracy of measurement falls also has this.

[0010] It tends to offer the ingredient degradation detection equipment by the positron annihilation method which can carry to a measurement site and can be measured safely while this invention was made in view of the trouble of this conventional technique, does not need to destroy and obtain a device under test and can measure it simply and with high precision.

[0011]

[Means for Solving the Problem] In order to solve the technical problem which the above-mentioned conventional technique has, the ingredient degradation detection equipment by the positron annihilation method of this invention In the ingredient degradation detection equipment by the positron annihilation method equipped with the gamma ray detector which measures the energy distribution of the gamma ray which irradiates the positive electron generated in the source of positive electron, and this source of positive electron at a device under test, and is produced by pair annihilation with an electron It is characterized by attaching said source of positive electron in one through backing material ahead of said gamma ray detector.

[0012] Moreover, the ingredient degradation detection equipment by the positron annihilation method of this invention is a thing smoothly with the description about having supported said source of positive electron removable through the flexible support device possible [adhesion to a device-under-test front face and parallel] ahead of said gamma ray detector of the 1st invention.

[0013] Furthermore, the ingredient degradation detection equipment by the positron annihilation method of this invention is characterized by establishing the range adjustment device in which the distance of said source of positive electron and said gamma ray detector is adjusted according to the generating positive electron in the source of positive electron ahead of said gamma ray detector of the 1st and the 2nd invention.

[0014] Moreover, the ingredient degradation detection equipment by the positron annihilation method of this invention is characterized by having covered the adhesion side to the device under test of the 1st thru/or said source of positive electron of the 3rd invention with the polymer film, and considering as a sealed source.

[0015] Furthermore, the ingredient degradation detection equipment by the positron annihilation method of this invention is characterized by preparing the cap equipped with wrap lead for the front face of said source of positive electron ahead of this electric shielding cylinder removable while it prepares the electric shielding cylinder equipped with lead in the side of the 1st thru/or said source of positive electron of the 4th invention.

[0016]

[Function] It is [detection] ready only by trying to attach the source of positive electron in one through BAKKIN material, such as aluminum, ahead of a gamma ray detector, and pressing this source of positive electron in parallel with a device under test the whole gamma ray detector, and enables it to detect degradation of an ingredient according to the ingredient degradation detection equipment by this positron annihilation method.

[0017] Moreover, he is trying to attach with a screw etc. the source of positive electron prepared ahead of a gamma ray detector free [attachment and detachment] through a flexible support device with a spring etc. according to the ingredient degradation detection equipment by this positron annihilation method. While absorbing a gap of the direction with ** of a gamma ray detector by flexible support devices, such as a spring, and enabling it to stick it in parallel with a device-under-test front face Demount only this source of positive electron from a flexible support device part, and it enables it to contain in a leaden pot etc., and enables it to carry out conveyance etc. to insurance.

[0018] Furthermore, according to the ingredient degradation detection equipment by this positron annihilation method, establish a range adjustment device between the sources of positive electron prepared ahead of a gamma ray detector, and it enables it to adjust distance, and the number of collapse or reinforcement of the source of positive electron adjusts the location of a gamma ray detector, and it can be made to make a Measuring condition the same, and can be made to perform highly precise detection also by the source of positive electron to which reinforcement falls with the passage of time.

[0019] Moreover, safety is improved, while according to the ingredient degradation detection equipment by this positron annihilation method decreasing conveyance and constraint of a measurement location as a sealed source by trying to cover the adhesion side to the device under test of BAKKIN material, such as aluminum of the source of positive electron ahead of a gamma ray detector, and the opposite side with a polymer film, and covering this source of positive electron

with BAKKIN material and a polymer film and making handling easy.
[0020] furthermore , while prepare the electric shielding cylinder equipped with leaden lining in the side of the source of a positive electron according to the ingredient degradation detection equipment by this positron annihilation method , it have prepare so that the cap also ahead equipped with leaden lining may be detach and attach , and the safety in the case of carry in a measurement site etc. can improve further , and it enable it to prevent the effect of the external noise from the side by remove only a cap in the case of measurement .
[0021]
[Example] Hereafter, the example of this invention is explained to a detail based on a drawing. For the expanded sectional view for points, such as a flexible support device, and drawing 3 , the A-A view Fig. in drawing 2 and drawing 4 are [the sectional view which drawing 1 - drawing 6 start one example of the ingredient degradation detection equipment by the positron annihilation method of this invention, and drawing 1 makes only a part for a point the longitudinal section, and is shown, and drawing 2 / drawing of longitudinal section of a justification device and drawing 6 of the outline perspective view for points, such as an attachment-and-detachment device, and drawing 5] the cross-sectional views of a justification device.
[0022] As the ingredient degradation detection equipment 10 by this positron annihilation method has offered the cylinder-like support cylinder 11 and shows it to that point at drawing 4 , it projects from three circumferencial directions, the Maine arm 12 is attached in one, three Maine arms 12 narrow along with a conical surface, after [when a point is parallel to the medial axis of the support cylinder 11] being level, it is bent in the shape of L character toward a core, and the fixed part 13 is formed. The tip of the spring 15 which constitutes the flexible support device 14 in the fixed part 13 at the tip of this Maine arm 12 is attached in one, and the stationary plate 17 by which the female screw 16 was formed in the back end of this spring 15 is attached in one.
[0023] The source holder 19 of positive electron which supports the positive electron wearing object 18 with which source of positive electron 18a was unified is attached in the stationary plate 17 prepared in radial [these / three] free [attachment and detachment] with a bolt 20.
[0024] This source holder 19 of positive electron is equipped with the ring-like tie-down plate 21 as shown in drawing 1 - drawing 4 . Project outside to the three circumferencial directions, and the fixed part 13 of the Maine arm 12 and the attachment section 22 which can be made to counter are formed. A bolt 20 is inserted. Bind tight and fix to the female screw 16 of a fixed part 13, or By being able to loosen and demount a bolt 20, rotating the attachment section 22 of the source holder 19 of positive electron to the circumference of the medial axis of the support cylinder 11 to the fixed part 13 of the Maine arm 12, and making it shift from an opposite location The source holder 19 of positive electron can be taken out ahead of the Maine arm 12.
[0025] In this source holder 19 of positive electron, along with a conical surface, three support arms 23 are arranged at circumferencial direction regular intervals ahead of the tie-down plate 21 on a ring, it has attached in one, and the source of positive electron fixed cylinder-like cylinder 24 is attached at the tip of these support arm 23.
[0026] Two stop screws 25 are thrust into the diagonal location of this source of positive electron fixed cylinder 24, and it can fix now on both sides of the positive electron wearing object 18 with which source of positive electron 18a was unified.

[0027] The positive electron wearing object 18 with which source of positive electron 18a which inserts and is attached in this source of positive electron fixed cylinder 24 with the stop screw 25 was unified For example, as shown in drawing 2 , the nickel foil 27 whose thickness is about 0.05mm ahead of [whose thickness a diameter is about 3mm in about 5mm] the disc-like backing material 26 made from aluminum is arranged. The germanium 68 which is the radioisotope whose diameter is about 1mm is arranged as source of positive electron 18a at these cores. Furthermore, the laminating of the polymer film 28 with a thickness of about 0.1mm is carried out to the outside, and an aluminum plate 29 is wound around these perimeters, and it is constituted so that it may press down in the bending section 30 of both ends and a laminating condition may be held.
[0028] Next, drawing 5 and drawing 6 explain the attachment structure of the gamma ray detector 31 to the support cylinder 11.
[0029] Two slide rails 32 are attached [the circumferencial direction of the inner circumference of the cylinder-like support cylinder 11] in the location equally divided into three at shaft orientations and parallel, and the slider 33 which fits in with two slide rails 32, and is slid and with which it is and the slot was formed is attached in the outside of the detector attachment cylinder 34 of the shape of a ring arranged at three shaft orientations, and can slide now to shaft orientations

to the support cylinder 11. Moreover, in the one remaining places equally divided into three at the circumferencial direction of the support cylinder 11, it projects outside, the PIONION attachment section 35 is formed, a pinion 36 is formed, it pinches to the revolving shaft of the outside of the pinion attachment section 35 of a pinion 36, 37 is prepared, and it has come to be able to carry out a rotation drive by hand at them. And the rack 38 which gears with this pinion 36 is fixed to the outside of the detector attachment cylinder 34, and the range adjustment device 39 which can move the detector attachment cylinder 34 to shaft orientations to the support cylinder 11 by rotating a pinion 36 with a tongue 37 is constituted.

[0030] A gamma ray detector 31 is attached in the interior of such a detector attachment cylinder 34 of the range adjustment device 39, and it is made for the sensor part to have become the source of positive electron 18a side.

[0031] In addition, although the illustration abbreviation was carried out, the fixed device with a screw etc. is prepared in this range adjustment device 39 so that it can fix after adjusting a gamma ray detector 31 to predetermined distance to source of positive electron 18a.

[0032] Thus, with the ingredient degradation detection equipment 10 by the constituted positron annihilation method, detection of degradation of Ingredient M is performed as follows.

[0033] First, it fixes with two stop screws 25, and the positive electron wearing object 18 with which source of positive electron 18a by which the laminating condition was held in the bending section 30 of an aluminum plate 29 was united with the source of positive electron fixed cylinder 24 at the tip of the source holder 19 of positive electron as preparation is contained and kept in the pot made from lead etc. the whole source holder 19 of positive electron.

[0034] On the other hand, the gamma ray detector 31 is attached in the detector attachment cylinder 34 inside the support cylinder 11.

[0035] In this way, after preparation is completed, the source holder 19 of positive electron put into support cylinder 11 part and the pot made from lead is carried to a site with a device under test M. After [of the tip of the Maine arm 12 of the point of the support cylinder 11 / three places / which flies fixed part 13] putting in the three attachment sections 22 of the end face section of the source holder 19 of positive electron inside the Maine arm 12 so that it may not be flooded, Rotate to the circumference of the medial axis of the support cylinder 11, a stationary plate 17 and the attachment section 22 are made to counter, and it fixes with a bolt 20.

[0036] The source holder 19 of positive electron with which the positive electron wearing object 18 with which source of positive electron 18a was unified was attached by this is attached at the tip of the Maine arm 12 of the support cylinder 11 through a spring 15, to the support cylinder 11, it can incline to a medial axis or the positive electron wearing object 18 with which source of positive electron 18a was unified can move to a cross direction.

[0037] After this, the tongue 37 of the range adjustment device 39 is rotated, and it fixes by the fixed device in which adjust the distance of a gamma ray detector 31 and it is not illustrated to source of positive electron 18a.

[0038] Even if the reinforcement of the generating positive electron from source of positive electron 18a changes with these range adjustment devices 39, the location of a gamma ray detector 31 is changeable with this, and even if the reinforcement of generating positive electron falls by the passage of time etc. especially, it can be used further.

[0039] In this way, after all detection preparations are completed, as shown in drawing 1 and drawing 2 , the positive electron wearing object 18 with which source of positive electron 18a at source holder of positive electron 19 tip was united with the measurement part of a device under test M the whole support cylinder 11 is pressed.

[0040] Since the positive electron wearing object 18 with which source of positive electron 18a was unified is supported by the support cylinder 11 through the spring 15 through the source holder 19 of positive electron even if the measurement part of a device under test M is an inclined plane etc. at this time, even if the location of the support cylinder 11 shifts somewhat, the positive electron wearing object 18 with which source of positive electron 18a was unified in parallel with a measuring plane-ed can be stuck.

[0041] Degradation of Ingredient M is detectable by measuring the energy distribution of the gamma ray from the measurement part of a device under test M with a gamma ray detector 31 in this condition.

[0042] Although positive electron is irradiated not only in a measuring plane-ed but in other directions and may serve as a noise when measuring the gamma ray from this measured part with a gamma ray detector 31 Since the backing material 26 of AMUMINIUMU arranges at the tooth back of source of positive electron 18a and the positive electron wearing object 18 is constituted From aluminum, the gamma ray from Ingredient M can be measured in the condition of always having been stabilized from the gamma ray of fixed energy occurring that what is necessary is just to take the effect only from this part into consideration.

[0043] Moreover, source of positive electron 18a is arranged on the backing material 26 and the nickel foil 27, and it covers with the polymer film 28, as a perimeter is surrounded with an aluminum plate 29, the positive electron wearing object 18 is constituted from this equipment, it becomes a sealed source, and there is also little regulation on law, that handling is easy for it, and there is also little constraint of a measurement location and it can perform measurement in a site simply.

[0044] Next, although drawing 7 and drawing 8 explain other one example of this invention, the same notation is described about the same part as the already explained example, and explanation is omitted.

[0045] With the ingredient degradation detection equipment 40 by this positron annihilation method, the electric shielding cylinder 41 is attached so that he may try to suppress the accuracy-of-measurement fall by improvement in the safety of the conveyance to a measurement site etc., and the external noise as much as possible and the side of the Maine arm 12 of the point of the support cylinder 11 or source wearing object of positive electron 18 grade may be covered. Inside this electric shielding cylinder 41, the lining 42 of the lead which covers positive electron and a gamma ray is attached. And the cap 43 which can be detached and attached was attached in the point of this electric shielding cylinder 41, and when it is measurement, it demounts and has come to keep attached in the cases, such as conveyance. The leaden lining 44 is attached also inside this cap 43. In addition, other configurations are the same as that of the already explained example.

[0046] Although only cap 43 is demounted and used by preparing such the electric shielding cylinder 41 and cap 43 in the case of measurement, since the side of the source wearing object 18 of positive electron is covered by the electric shielding cylinder 41 equipped with the leaden lining 42, it can prevent becoming an external noise by the gamma ray which irradiates in addition to a test section-ed, and is generated from source of positive electron 18a.

[0047] Moreover, by attaching cap 43 in the cases, such as conveyance, the positive electron from source of positive electron 18a can be covered completely, and it cannot have effect of those on the body etc., but can be dealt with further safely.

[0048] Furthermore, the same effectiveness as the already explained above-mentioned example also does so.

[0049] In addition, although germanium 68 was used as a source of positive electron, you may make it use not only this but other sources of positive electron in the above-mentioned example.

[0050] Moreover, although it was made to support through a spring as a flexible support device, you may carry out making it support through flexible material, such as not only this but rubber, etc.

[0051] Furthermore, a range adjustment device is also good also not only as a thing but other configurations depended on a rack-and-pinion.

[0052] Moreover, it cannot be overemphasized that this invention may add modification to each component in the range which does not deviate not only from each above-mentioned example but from the summary of this invention.

[0053]

[Effect of the Invention] As mentioned above, since the source of positive electron was attached in one through BAKKIN material ahead of the gamma ray detector according to the ingredient degradation detection equipment by the positron annihilation method of this invention as concretely explained with one example While it is [detection] ready only by pressing this source of positive electron in parallel with a device under test the whole gamma ray detector and being able to detect degradation of an ingredient easily, the noise of the gamma ray from other than a device under test can be kept constant, and detection precision can be maintained.

[0054] Moreover, since the source of positive electron prepared ahead of a gamma ray detector was attached free [attachment and detachment] through the flexible support device according to the ingredient degradation detection equipment by this positron annihilation method, while being able to absorb a gap of the direction with ** of a gamma ray detector by the flexible support device and being able to stick it in parallel with a device-under-test front face, only this source of positive electron can be demounted from a flexible support device part, it can contain in a leaden pot etc., and conveyance etc. can be carried out to insurance.

[0055] Furthermore, since a range adjustment device is established between the sources of positive electron prepared ahead of a gamma ray detector and it enabled it to adjust distance to it according to the ingredient degradation detection equipment by this positron annihilation method, even if it adjusts the location of a gamma ray detector, it can make a Measuring condition almost the same and the reinforcement of positive electron falls in connection with the passage of time etc. with the number of collapse or reinforcement of the source of positive electron, highly precise detection can be performed.

[0056] Moreover, safety can be improved, while according to the ingredient degradation detection equipment by this

positron annihilation method decreasing conveyance and constraint of a measurement location as a sealed source by covering this source of positive electron with BAKKIN material and a polymer film and making handling easy, since the adhesion side to the BAKKIN material of the source of positive electron ahead of a gamma ray detector and the device under test of the opposite side was covered with the polymer film.

[0057] Furthermore, while preparing the electric shielding cylinder equipped with leaden lining in the side of the source of positive electron according to the ingredient degradation detection equipment by this positron annihilation method Since it prepared so that the cap also ahead equipped with leaden lining could be detached and attached, the safety in the case of carrying in a measurement site etc. can be improved further, the effect of the external noise from the side can be prevented from lead by removing only a cap in the case of measurement, and the accuracy of measurement can be improved.

[Translation done.]

JAPANESE [JP,05-288694,A]

CLAIMS DETAILED DESCRIPTION TECHNICAL FIELD PRIOR ART EFFECT OF THE INVENTION TECHNICAL PROBLEM MEANS OPERATION EXAMPLE DESCRIPTION OF DRAWINGS DRAWINGS

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the sectional view shown by making only a part for the point concerning one example of the ingredient degradation detection equipment by the positron annihilation method of this invention into the longitudinal section.
[Drawing 2] The flexible support device concerning one example of the ingredient degradation detection equipment by the positron annihilation method of this invention etc. is an expanded sectional view for a point.
[Drawing 3] It is an A-A view Fig. in drawing 2 concerning one example of the ingredient degradation detection equipment by the positron annihilation method of this invention.
[Drawing 4] The attachment-and-detachment device concerning one example of the ingredient degradation detection equipment by the positron annihilation method of this invention etc. is an outline perspective view for a point.
[Drawing 5] It is drawing of longitudinal section of the justification device concerning one example of the ingredient degradation detection equipment by the positron annihilation method of this invention.
[Drawing 6] It is the cross-sectional view of the justification device concerning one example of the ingredient degradation detection equipment by the positron annihilation method of this invention.
[Drawing 7] It is outline drawing of longitudinal section concerning other one example of the ingredient degradation detection equipment by the positron annihilation method of this invention.
[Drawing 8] It is a side elevation concerning other one example of the ingredient degradation detection equipment by the positron annihilation method of this invention.
[Drawing 9] It is the approximate account Fig. of the ingredient degradation detection by the conventional positron annihilation method.
[Description of Notations]
10 Ingredient Degradation Detection Equipment by Positron Annihilation Method
11 Support Cylinder
12 Maine Arm
13 Fixed Part
14 Flexible Support Device
15 Spring
16 Female Screw
17 Stationary Plate
18 Source Wearing Object of Positive Electron
18a The source of positive electron
19 Source Holder of Positive Electron
20 Bolt
21 Tie-down Plate
22 Attachment Section
23 Support Arm
24 Source of Positive Electron Fixed Cylinder
25 Stop Screw
26 Backing Material
27 Nickel Foil

28 Polymer Film
29 Aluminum Plate
30 Bending Section
31 Gamma Ray Detector
32 Slide Rail
33 Slider
34 Detector Attachment Cylinder
35 Pinion Attachment Section
36 Pinion
37 Tongue
38 Rack
39 Range Adjustment Device
40 Ingredient Degradation Detection Equipment by Positron Annihilation Method
41 Electric Shielding Cylinder
42 Leaden Lining
43 Cap
44 Leaden Lining
M Device under test (ingredient)

[Translation done.]